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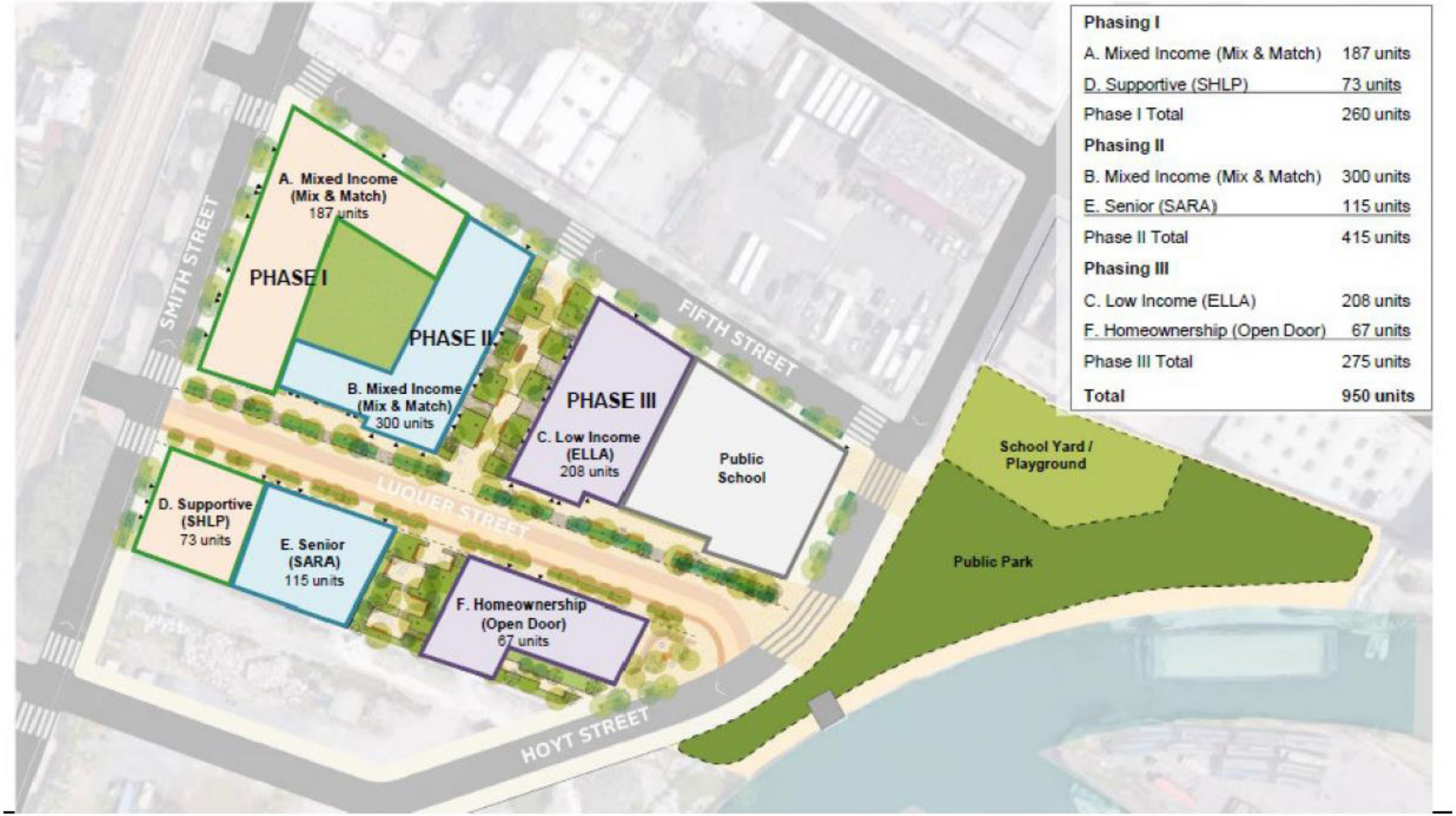
Mounding and Considerations for the Upland Remediation Strategy at the Former Citizens Gas Works MGP Site

RTA2 Gowanus Canal, Brooklyn, New York

October 14, 2021

PROPOSED AFFORDABLE HOUSING PHASING PLAN



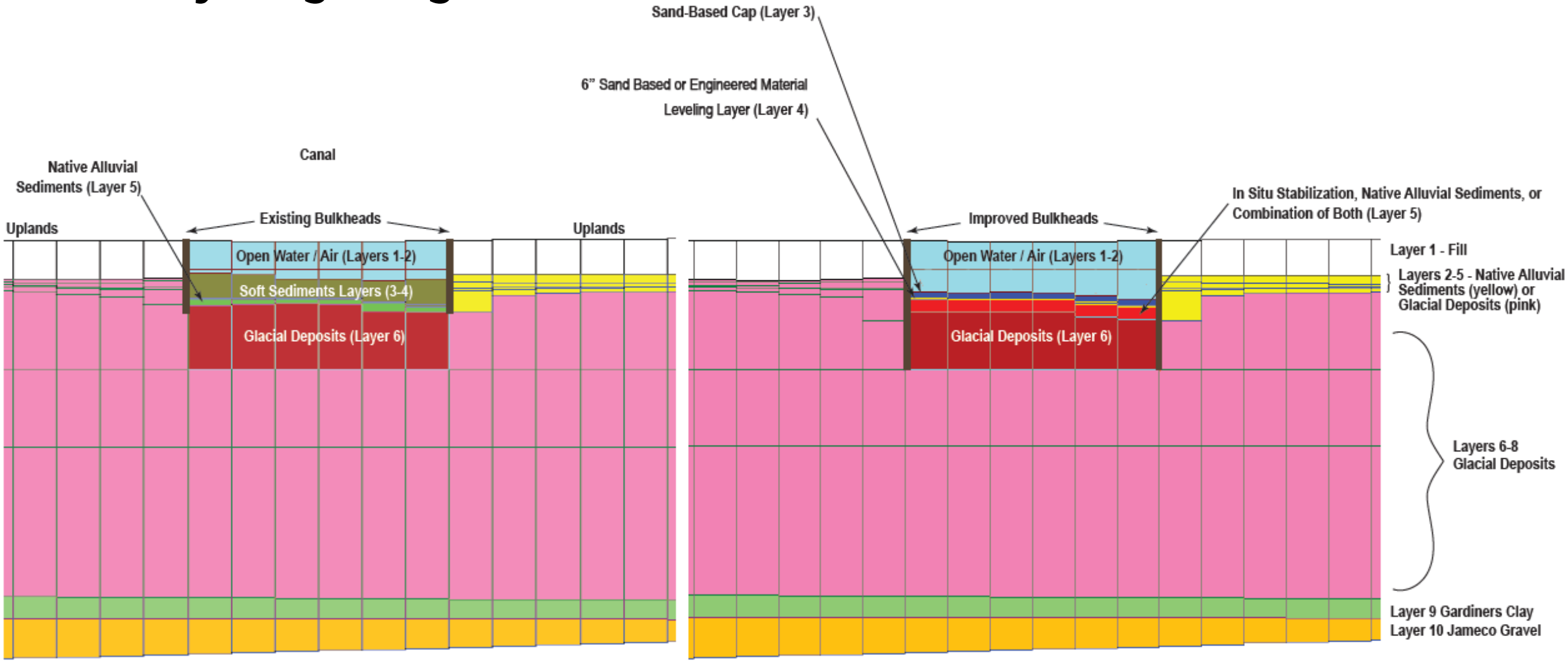
Phasing I	
A. Mixed Income (Mix & Match)	187 units
D. Supportive (SHLP)	73 units
Phase I Total	260 units
Phasing II	
B. Mixed Income (Mix & Match)	300 units
E. Senior (SARA)	115 units
Phase II Total	415 units
Phasing III	
C. Low Income (ELLA)	208 units
F. Homeownership (Open Door)	67 units
Phase III Total	275 units
Total	**950 units**

Citizens parcel with redevelopment footprints

Citizens Parcel Boundary (yellow outlines)

Redevelopment Footprints (black outlines)

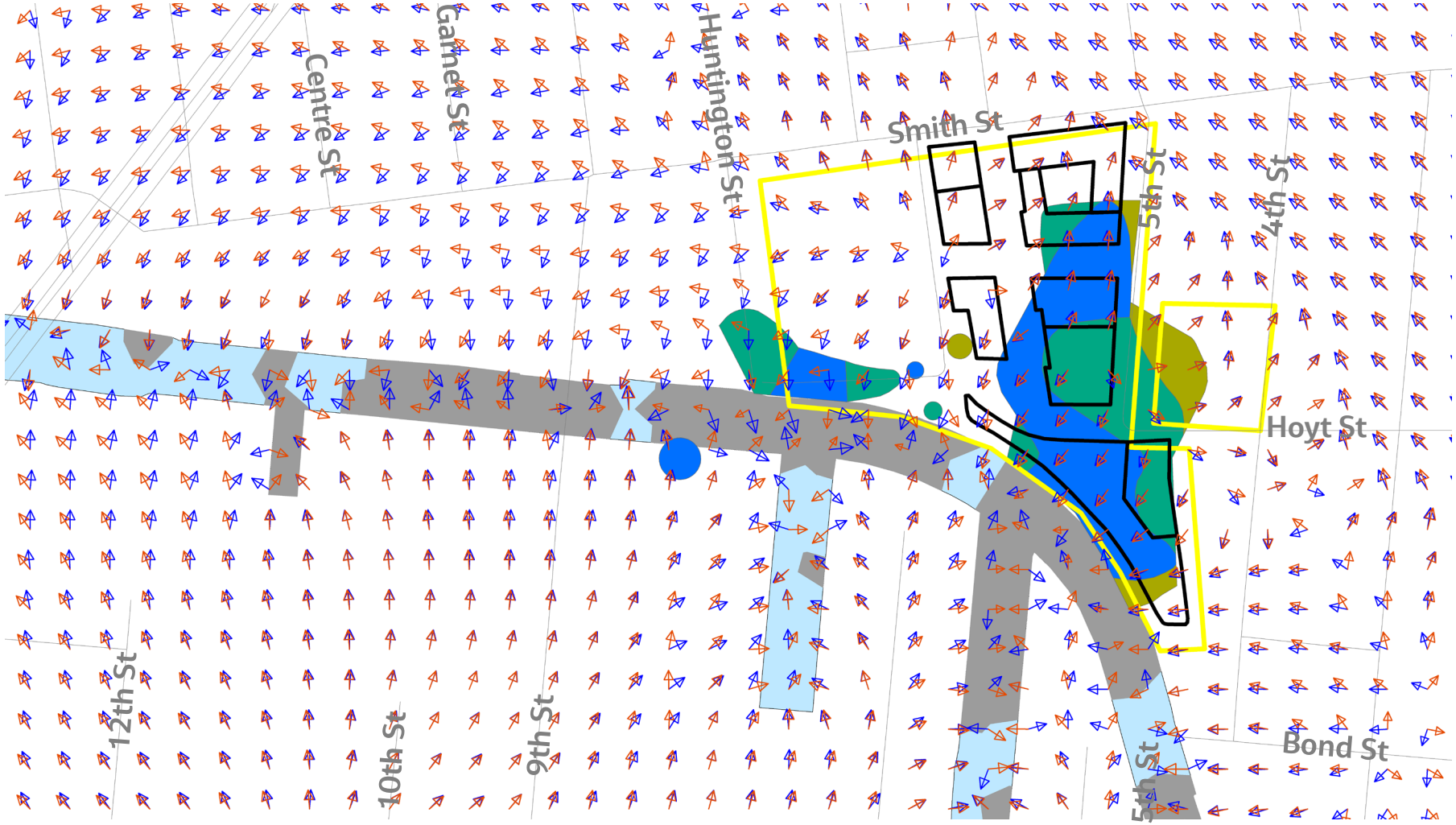
Model layering designations



Pre-Remedy Conditions

Post-Remedy Conditions

Groundwater flow directions: ISS /Alluvial sediments layer (L5)



LEGEND

- Baseline Flow Direction
- Post-remedy* Flow Direction
- Redevelopment Area
- ISS Area of Canal
- Non-ISS Area of Canal
- Citizens Parcel Boundary

NAPL Observations

- Tar Saturated
- Lenses with Tar Saturation & Tar/Naphtha Odors
- Blebs, Globs, Lenses, Coatings, Sheens, & Tar/Naphtha Odors

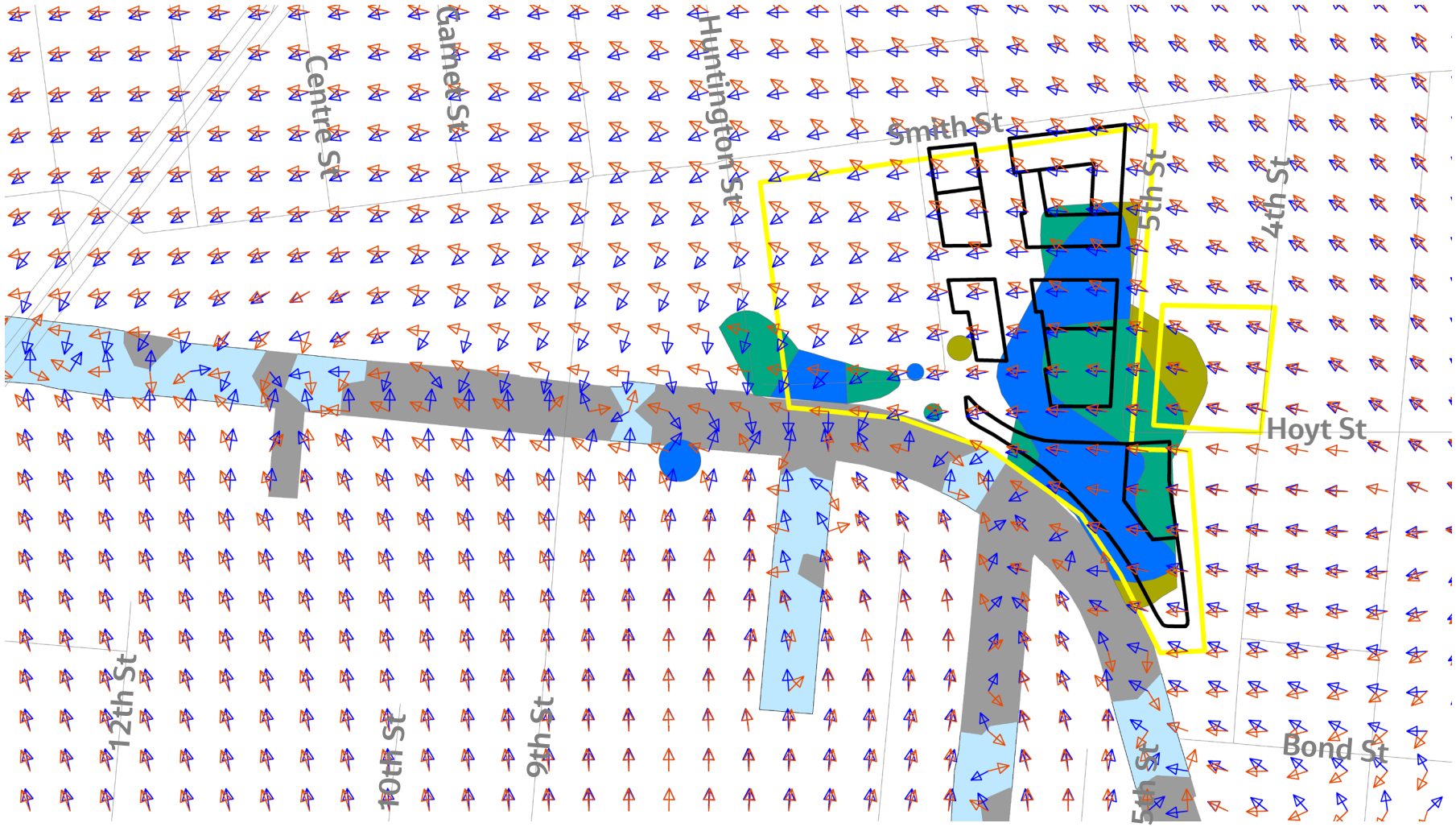
N

Approximate

0′ 200′

*Scenario 4

Groundwater flow directions: Glacial deposits layer (L6)



LEGEND

- Baseline Flow Direction
- Post-remedy* Flow Direction
- Redevelopment Area
- ISS Area of Canal
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- Citizens Parcel Boundary

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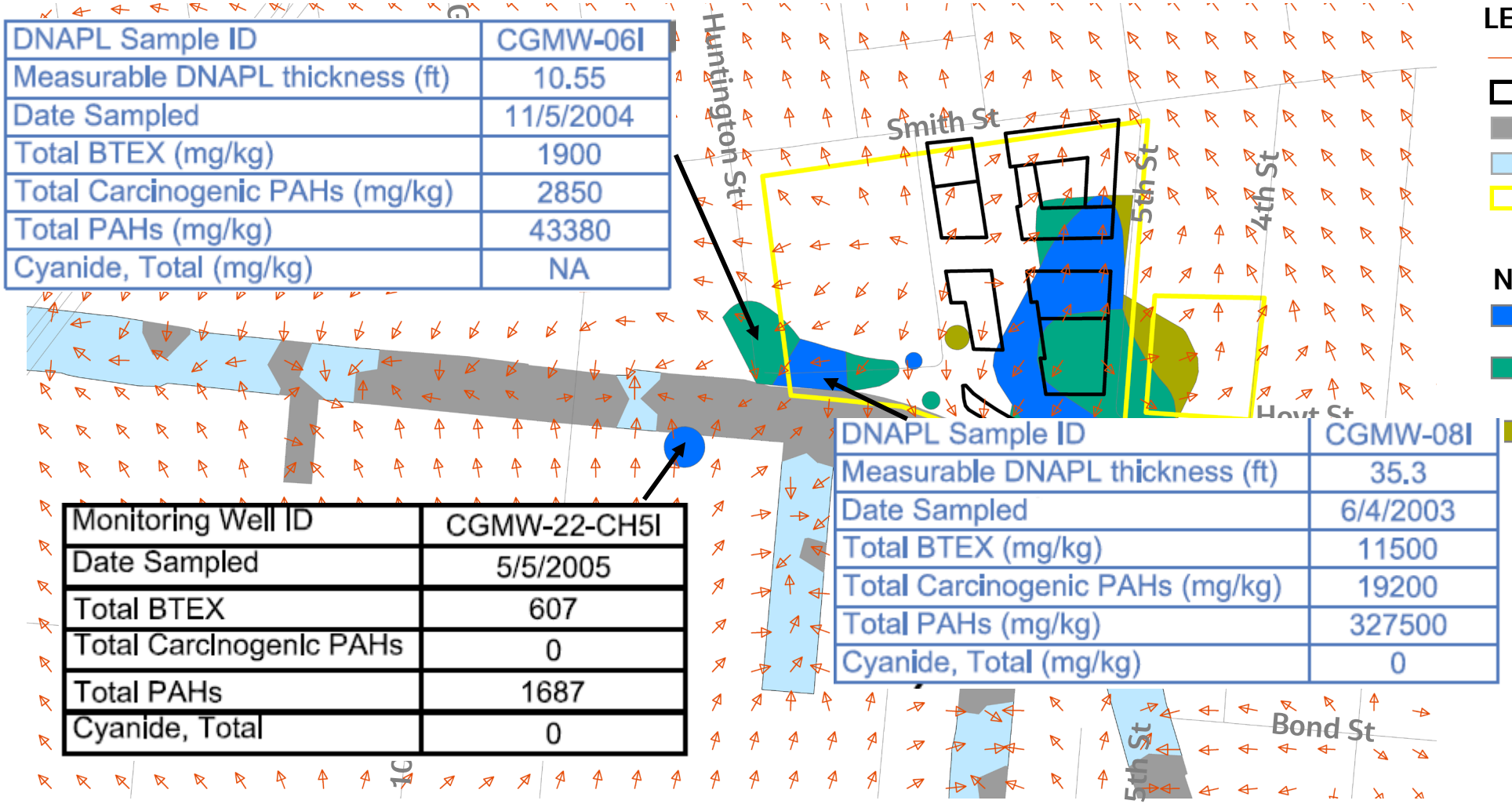
N

Approximate

0′ 200′

*Scenario 4

Groundwater flow directions: ISS /Alluvial sediments layer (L5)



DNAPL Sample ID	CGMW-06I
Measurable DNAPL thickness (ft)	10.55
Date Sampled	11/5/2004
Total BTEX (mg/kg)	1900
Total Carcinogenic PAHs (mg/kg)	2850
Total PAHs (mg/kg)	43380
Cyanide, Total (mg/kg)	NA

Monitoring Well ID	CGMW-22-CH5I
Date Sampled	5/5/2005
Total BTEX	607
Total Carcinogenic PAHs	0
Total PAHs	1687
Cyanide, Total	0

DNAPL Sample ID	CGMW-08I
Measurable DNAPL thickness (ft)	35.3
Date Sampled	6/4/2003
Total BTEX (mg/kg)	11500
Total Carcinogenic PAHs (mg/kg)	19200
Total PAHs (mg/kg)	327500
Cyanide, Total (mg/kg)	0

LEGEND

- Post-remedy* Flow Direction
- Redevelopment Area
- ISS Area of Canal
- Non-ISS Area of Canal
- Citizens Parcel Boundary

NAPL Observations

- Tar Saturated
- Lenses with Tar Saturation & Tar/Naphtha Odors
- Blebs, Globs, Lenses, Coatings, Sheens, & Tar/Naphtha Odors

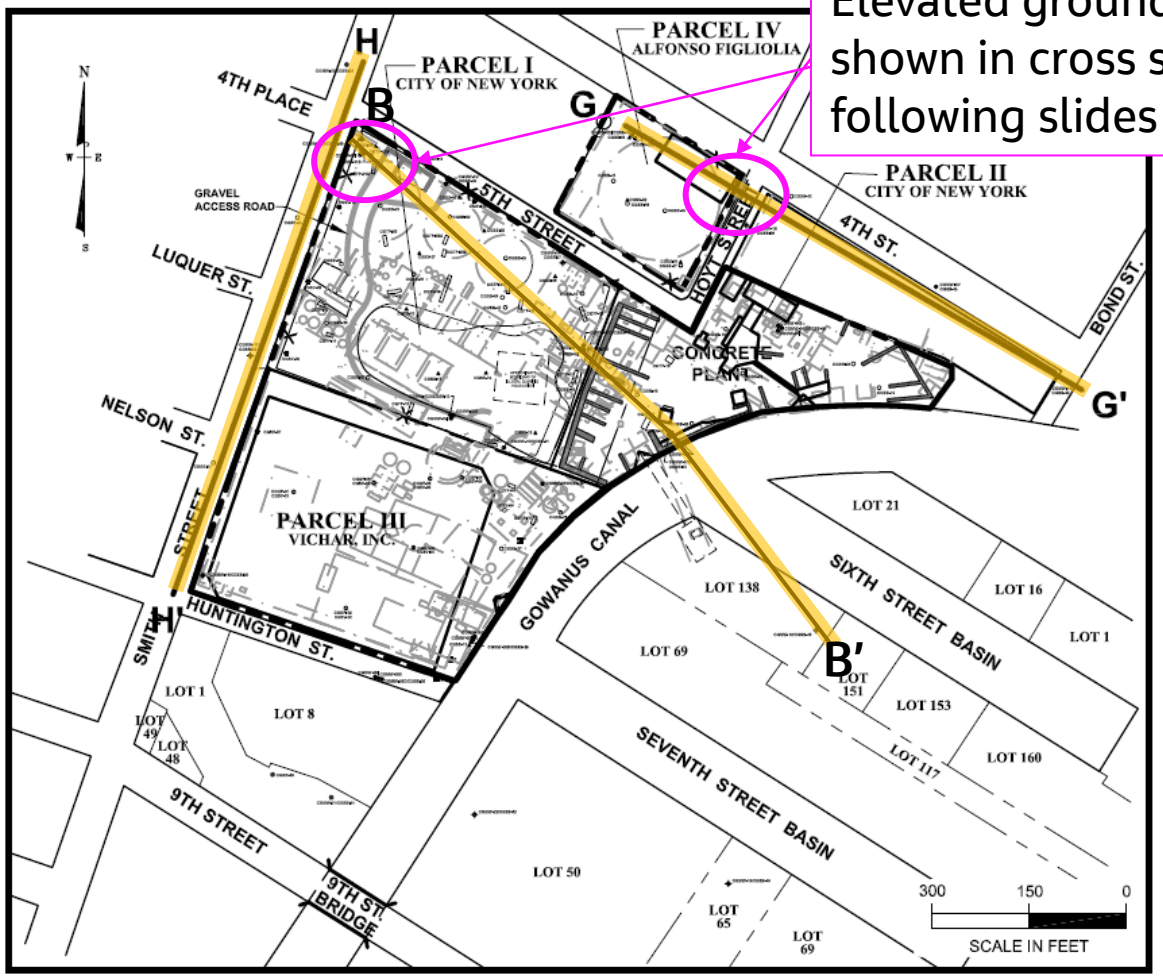
N

Approximate

0′ 200′

*Scenario 4

Shallow BTEX and PAH impacts



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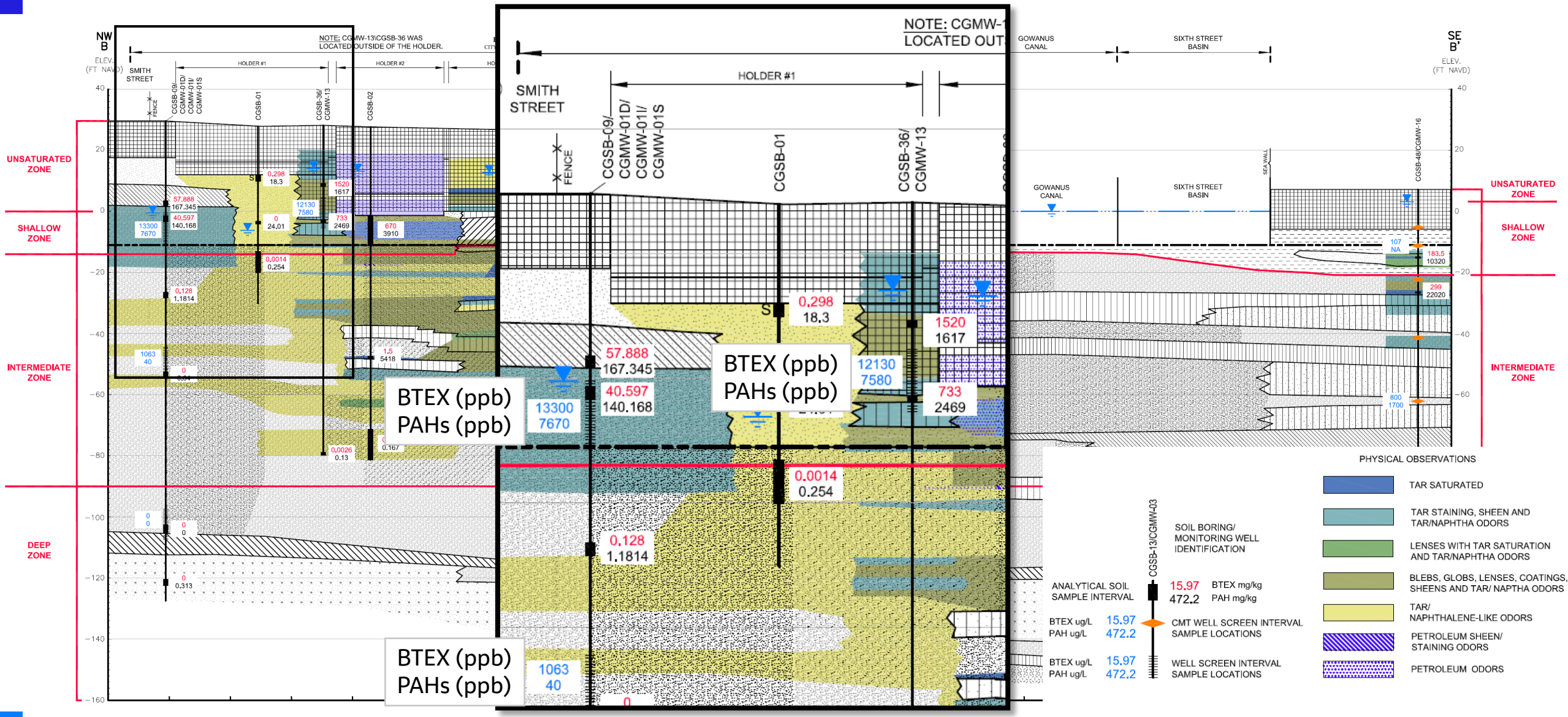
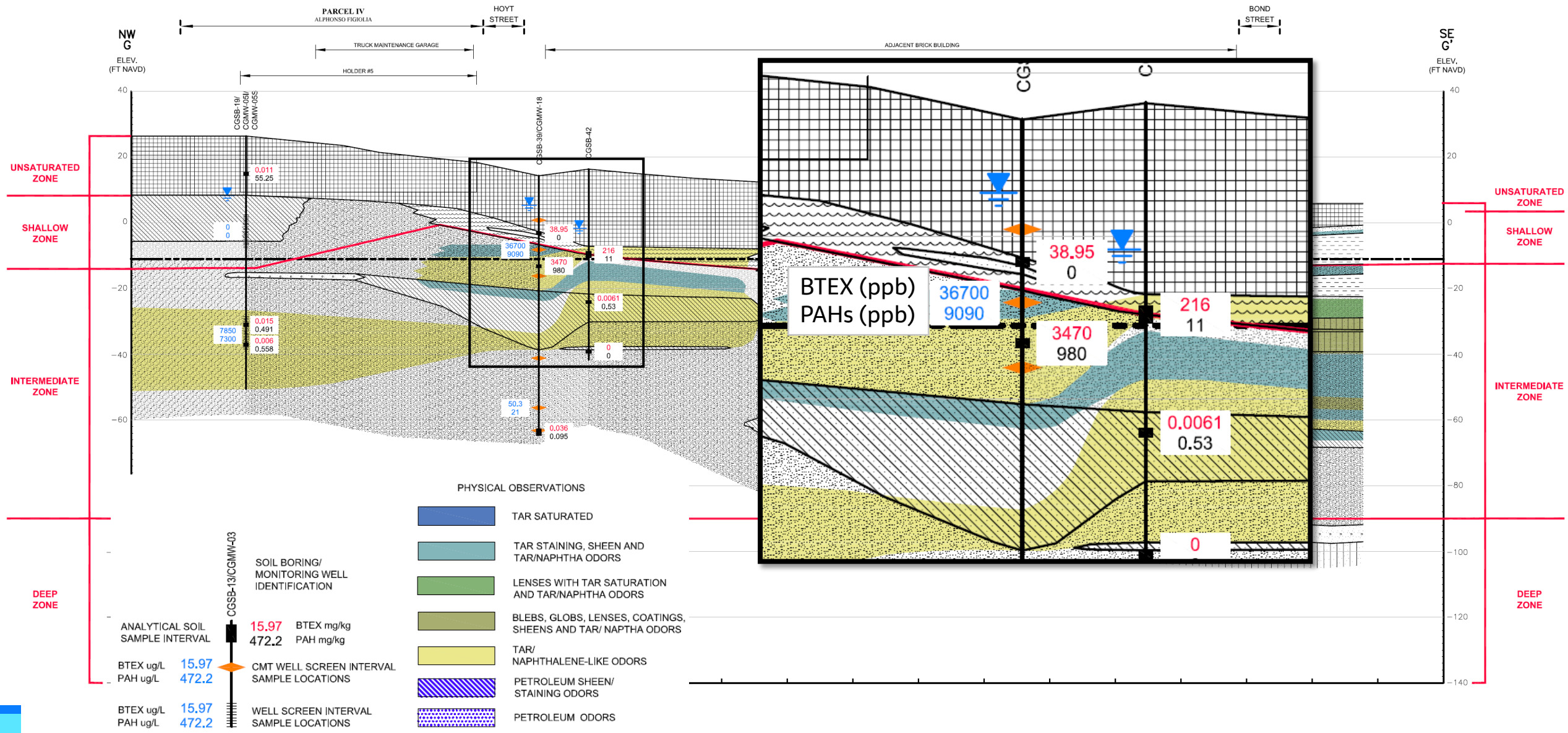
8


NW
B
SE
B'
ELEV. (FT NAVD)
SMITH STREET
HOLDER #1
HOLDER #2
NOTE: CGMW-13\CGSB-36 WAS LOCATED OUTSIDE OF THE HOLDER.
NOTE: CGMW-1 LOCATED OUT
FENCE
CGSB-09/ CGMW-01D/ CGMW-01I/ CGMW-01S
CGSB-01
CGSB-36/ CGMW-13
CGSB-02
GOWANUS CANAL
SIXTH STREET BASIN
SEA WALL
CGSB-48/CGMW-16
UNSATURATED ZONE
SHALLOW ZONE
INTERMEDIATE ZONE
DEEP ZONE
BTEX (ppb)
PAHs (ppb)
PHYSICAL OBSERVATIONS
TAR SATURATED
TAR STAINING, SHEEN AND TAR/NAPHTHA ODORS
LENSES WITH TAR SATURATION AND TAR/NAPHTHA ODORS
BLEBS, GLOBS, LENSES, COATINGS, SHEENS AND TAR/ NAPTHA ODORS
TAR/ NAPHTHALENE-LIKE ODORS
PETROLEUM SHEEN/ STAINING ODORS
PETROLEUM ODORS
SOIL BORING/ MONITORING WELL IDENTIFICATION
CGSB-13/CGMW-03
ANALYTICAL SOIL SAMPLE INTERVAL
15.97 BTEX mg/kg
472.2 PAH mg/kg
BTEX ug/L 15.97
PAH ug/L 472.2
CMT WELL SCREEN INTERVAL SAMPLE LOCATIONS
WELL SCREEN INTERVAL SAMPLE LOCATIONS



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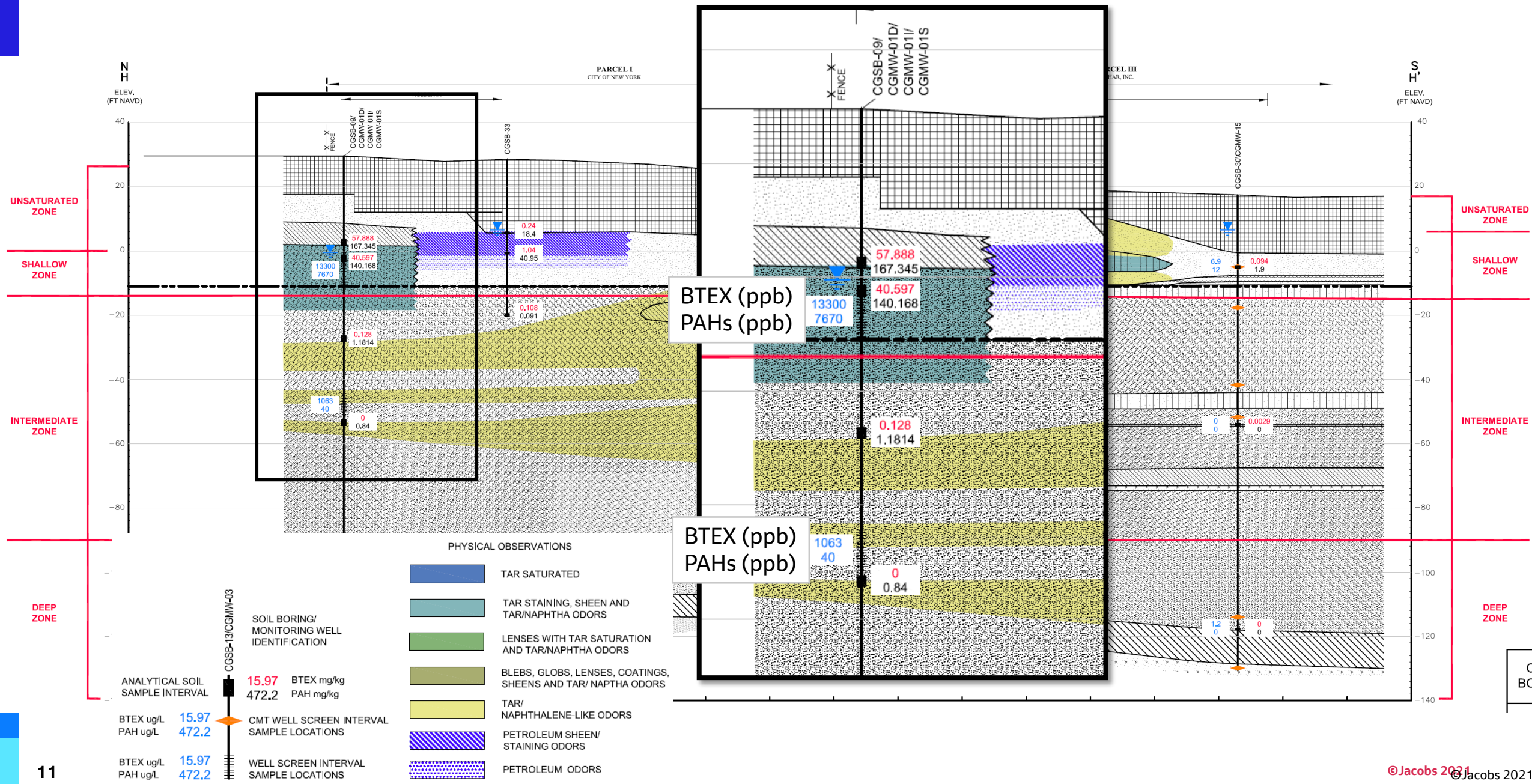

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NY State RAOs* (for general reference)

- Groundwater
  - Prevent, to the extent practicable, contact with, or ingestion of contaminated GW associated with the site.
  - Prevent, to the extent practicable, the migration of contaminated GW from the site.
  - Remove, to the extent practicable, the source of GW contamination.
- Soil
  - Prevent, to the extent practicable, injection/direct contact with contaminated soil.
  - Recover, to the extent practicable, DNAPL tar at the site.
- Indoor air
  - Prevent, to the extent practicable, inhalation of contaminants volatilizing from soil or GW into closed structures.

*EPA Briefing Package: Former Citizens Manufactured Gas Plant (MGP) site, 2021

Questions

- Contaminant migration control considerations
  - How many extraction wells & what combined flow rate might it take to capture contaminated GW within the Citizens parcel down thru the native alluvial sediments?
  - What volumetric capacity/flowrate may be anticipated for possible treatment and discharge based on assumed number of wells?
- NAPL recovery considerations
  - How might operation of hydraulic-capture extraction wells in the Citizens parcel affect NAPL migration from source areas?
  - What approach could be used to eliminate or minimize sources near groundwater pumping well locations?
- Mounding considerations
  - Following the in-canal remediation in RTA2, in conjunction with the new bulkheads that the remediation requires, will groundwater mounding occur at the Citizens site under steady state conditions?
  - How might operation of hydraulic-capture extraction wells in the Citizens parcel reduce mounding effects caused by implementation of the Canal remedy?

Contaminant migration control considerations

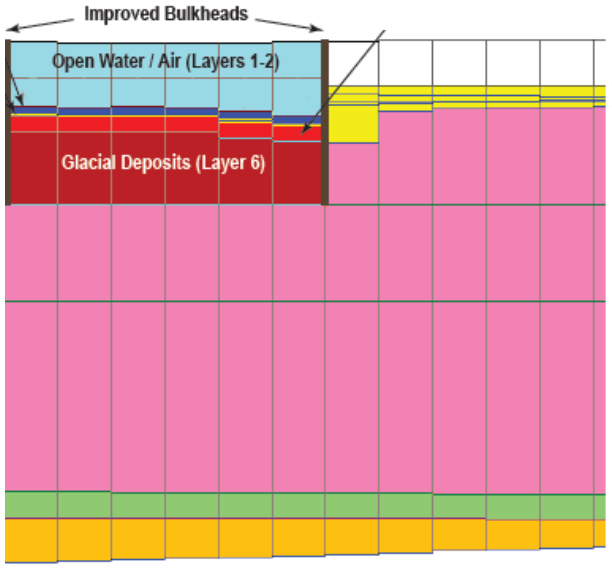
How many extraction wells & what combined flow rate might it take to capture contaminated GW within the Citizens parcel down thru the native alluvial sediments?

What volumetric capacity/flowrate may be anticipated for possible treatment and discharge based on assumed number of wells?

Models used for a preliminary hydraulic-capture evaluation

- Baseline conditions (RTA1_65 submittal from Geosyntec)
  - No bulkhead improvements
  - No Canal remedy
- Post-remedy conditions (Scenario 4 submittal from Geosyntec)
  - Bulkhead improvements
  - Canal remedy including drains down to 4 to 9.5’ bgs along upland side of improved bulkheads

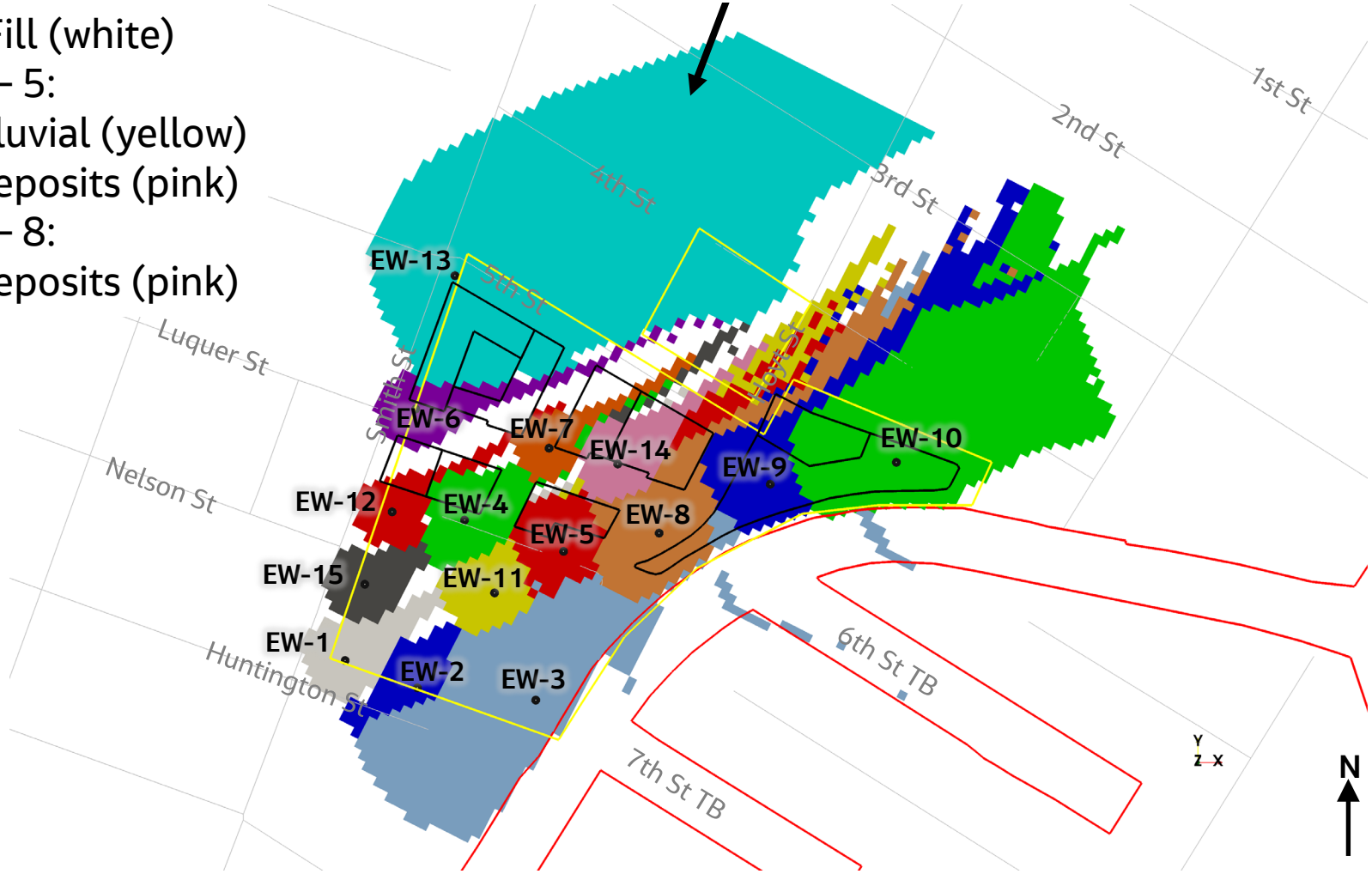
Steady-state capture zones – All layers



Layer 1: Fill (white)
Layers 2 – 5:
Native Alluvial (yellow)
Glacial Deposits (pink)
Layers 6 – 8:
Glacial Deposits (pink)

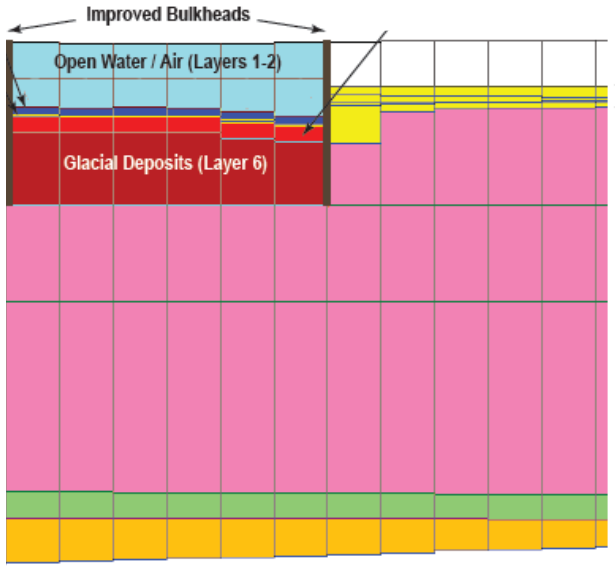
- Post-remedy conditions, but with 15 modeled extraction wells pumping a combined ~14 gpm.
- Modeled extraction wells are screened in Model Layers 1–5.
- Depth to bottom of Model Layer 5 at modeled extraction wells ranges from 26 to 38 feet bgs.

Colors represent capture zone for each well



This is not an extraction well-field design. A proper capture zone analysis would need to be done for the design.

Steady-state capture zones – Model layer 1



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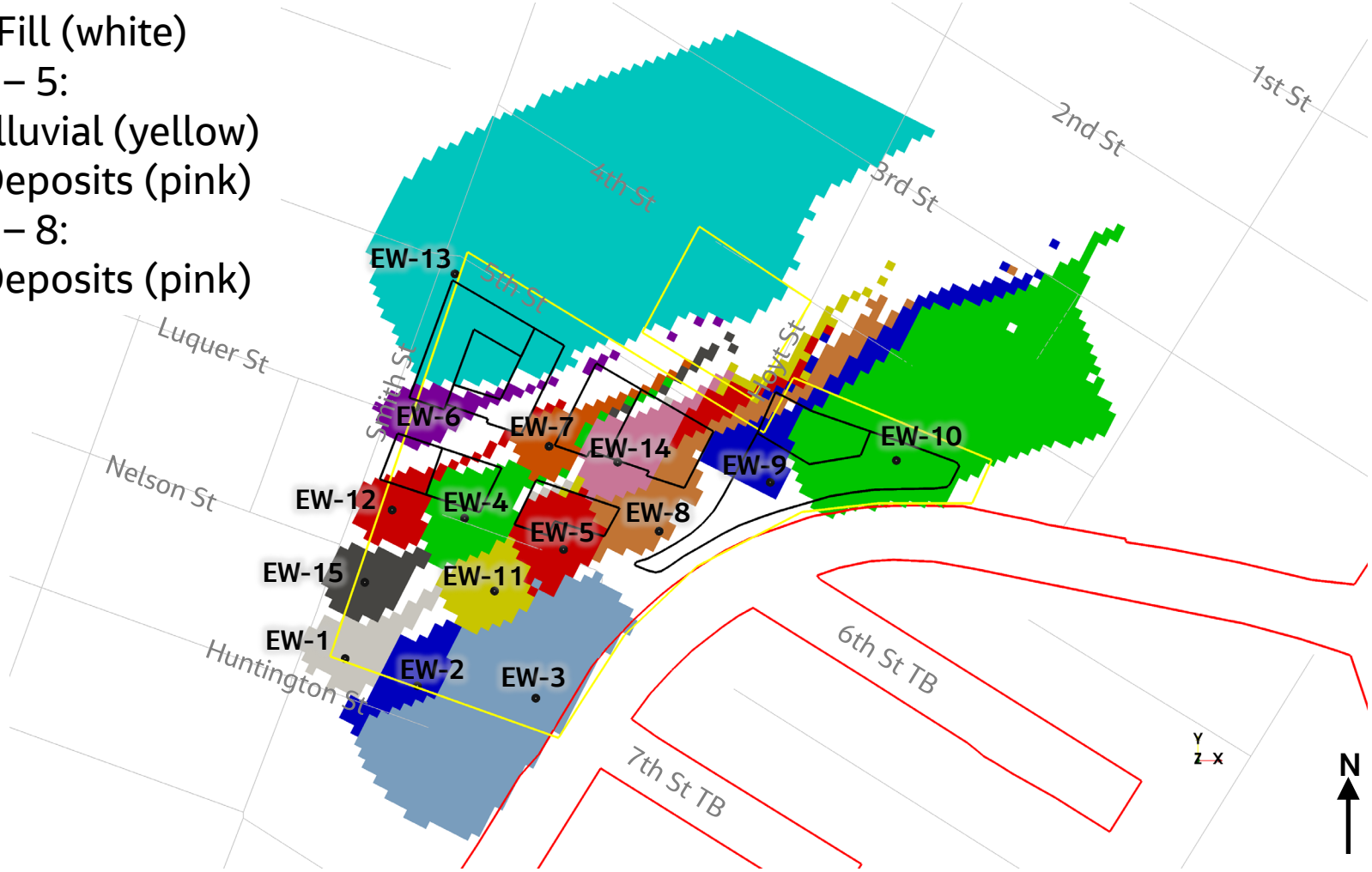

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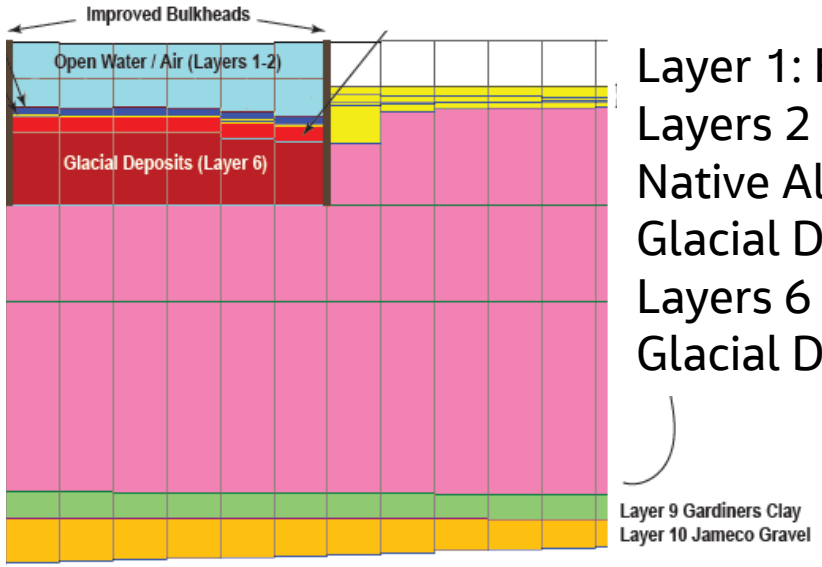
Steady-state capture zones – Model layer 2



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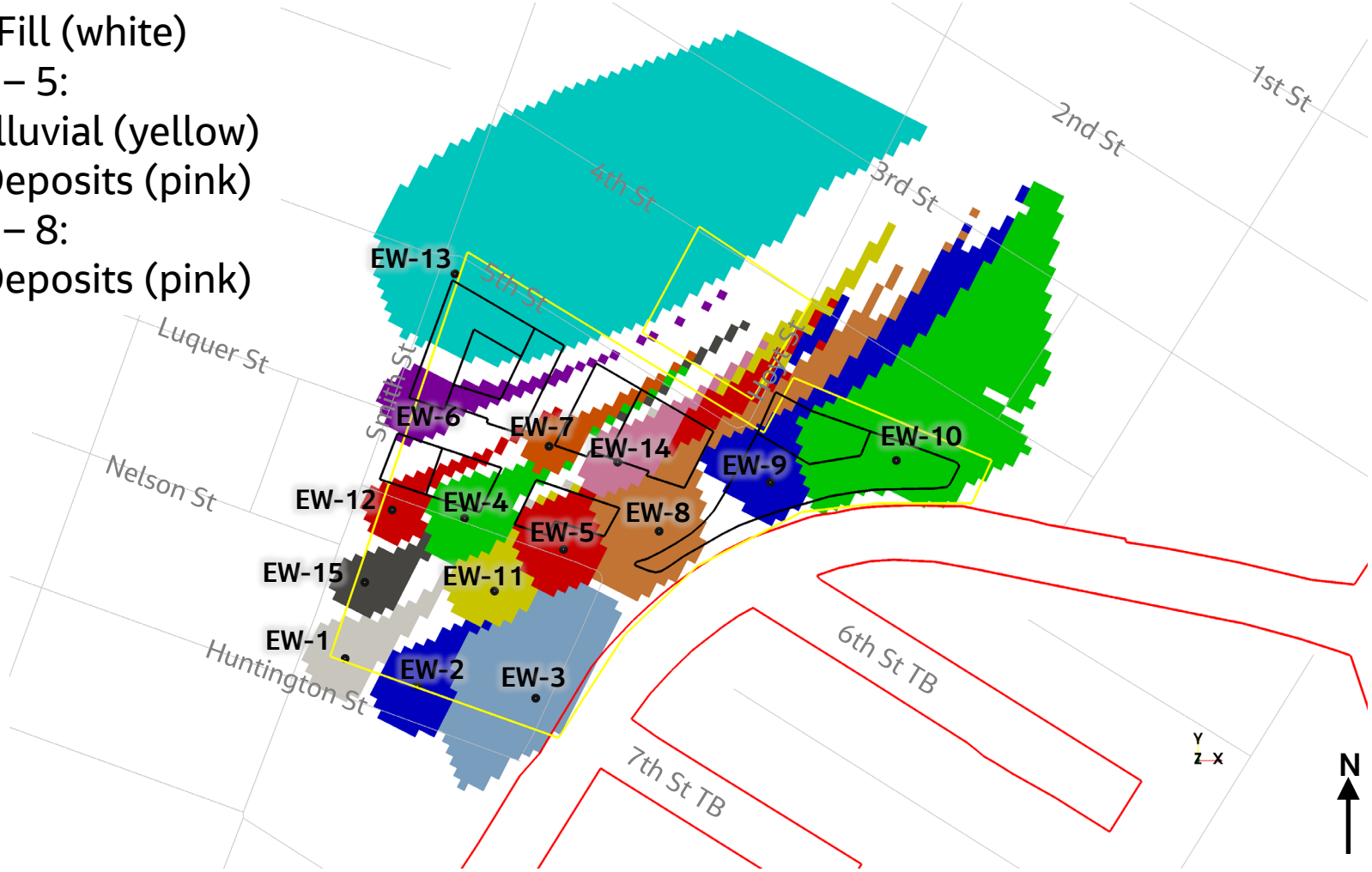

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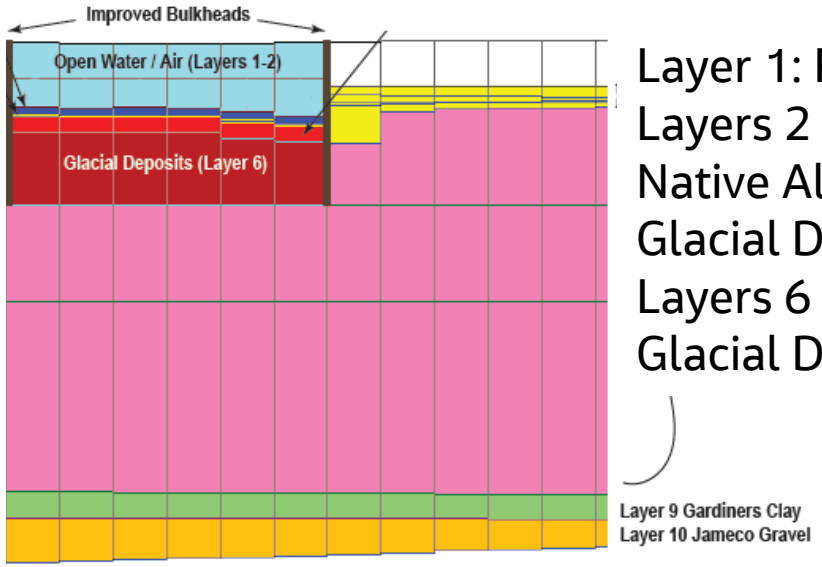
Steady-state capture zones – Model layer 3



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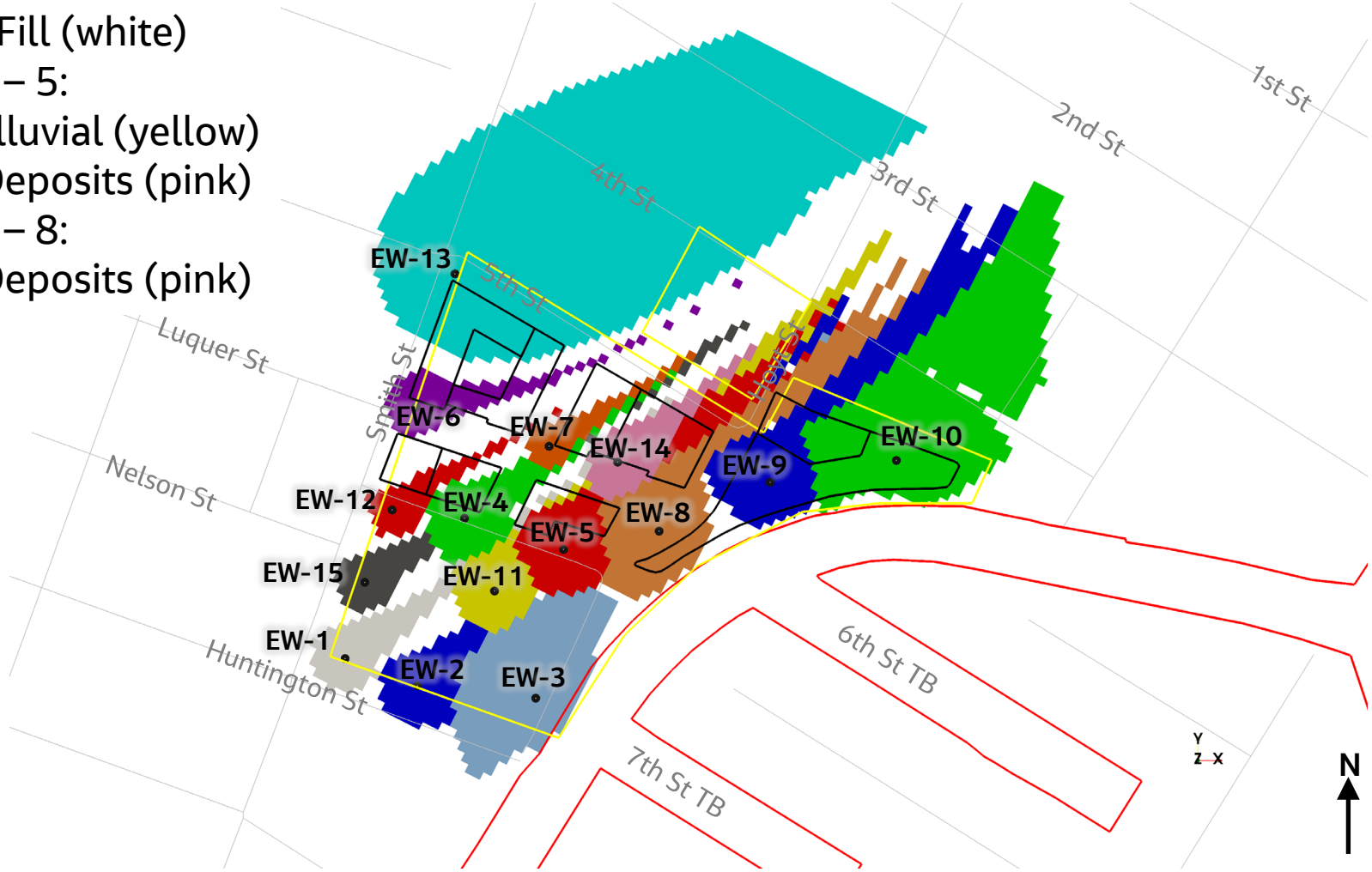

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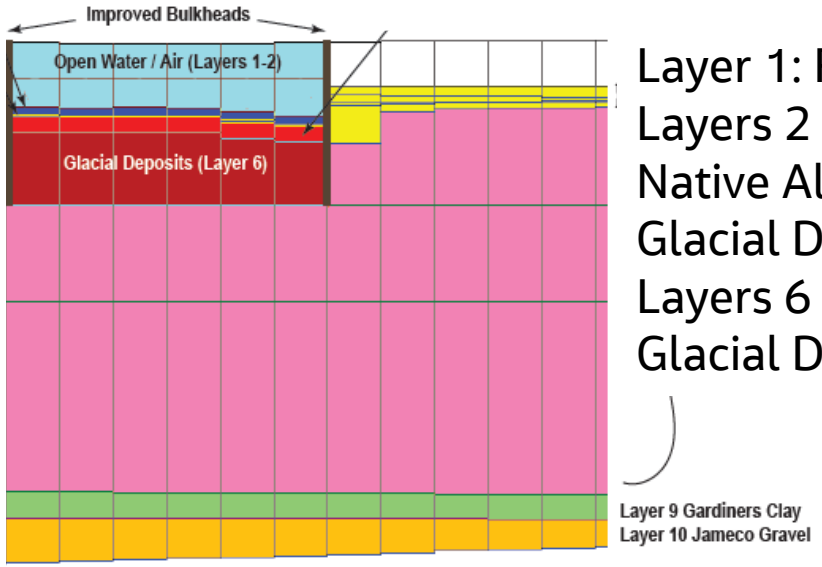
Steady-state capture zones – Model layer 4



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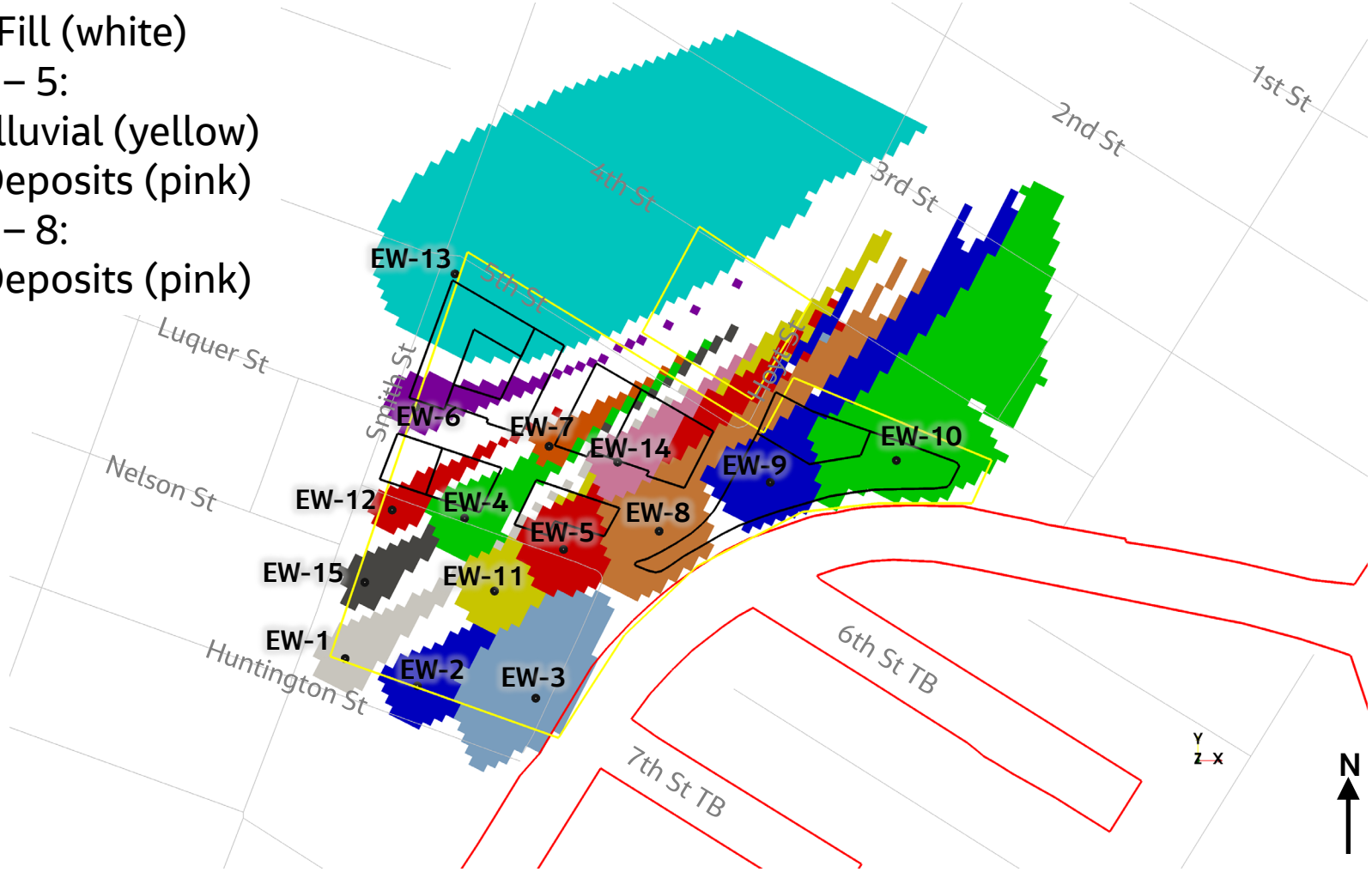

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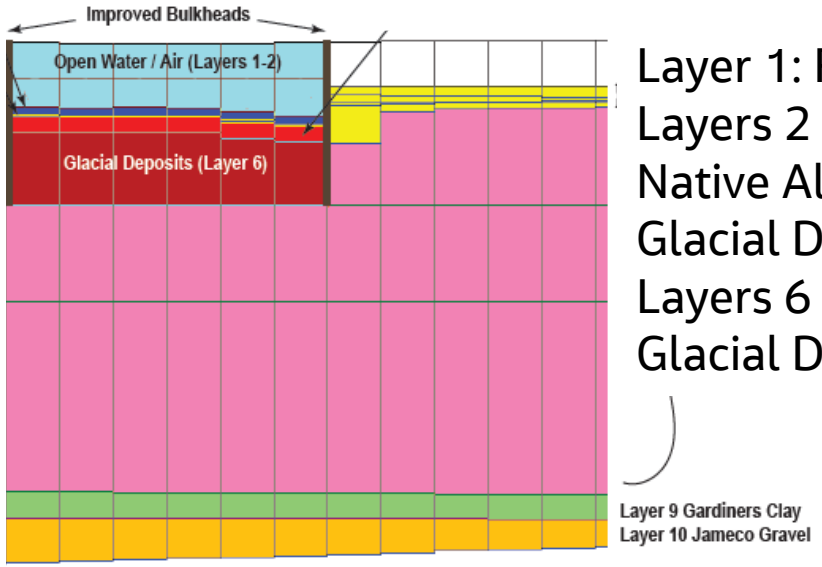
Steady-state capture zones – Model layer 5



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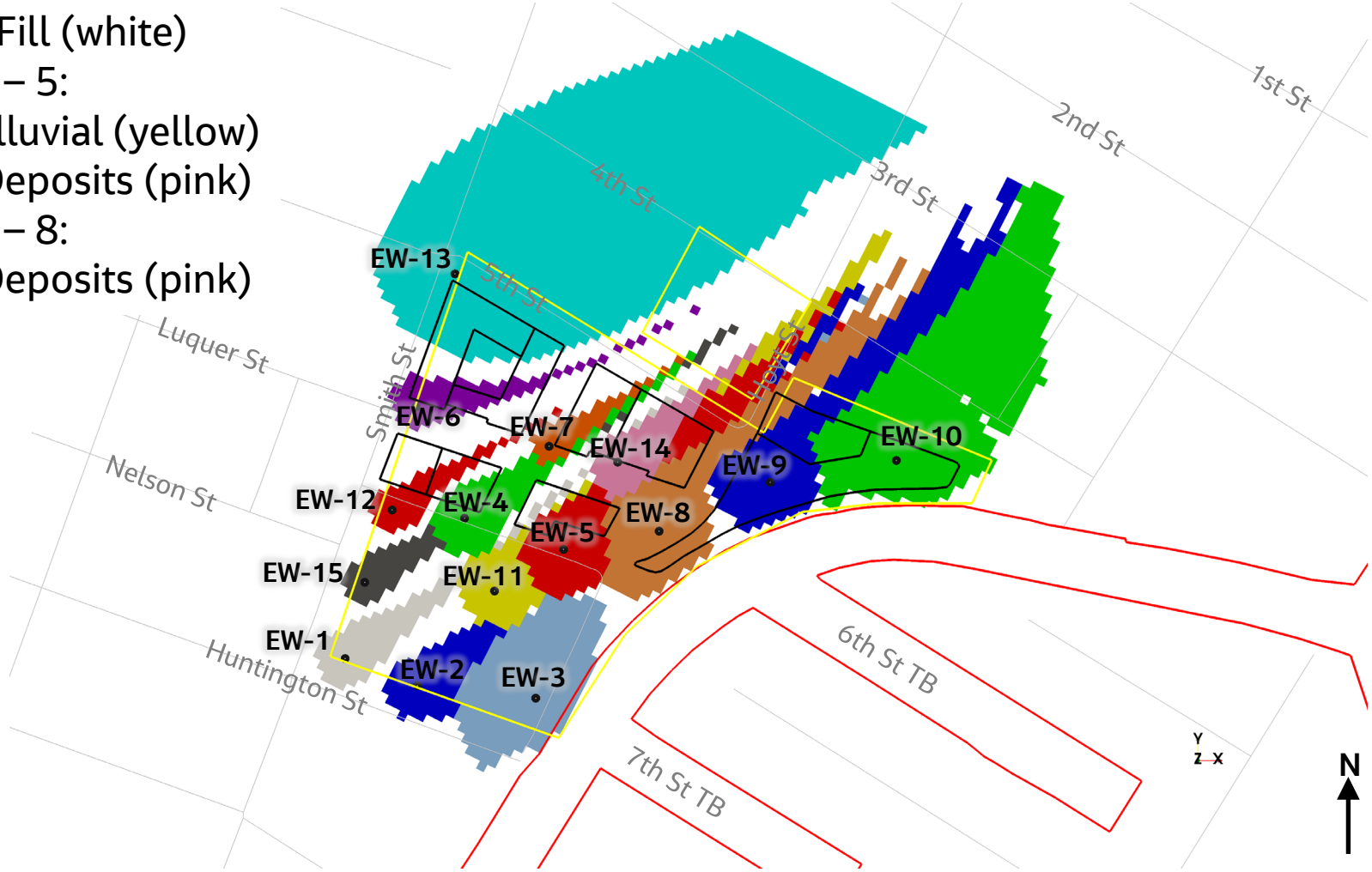

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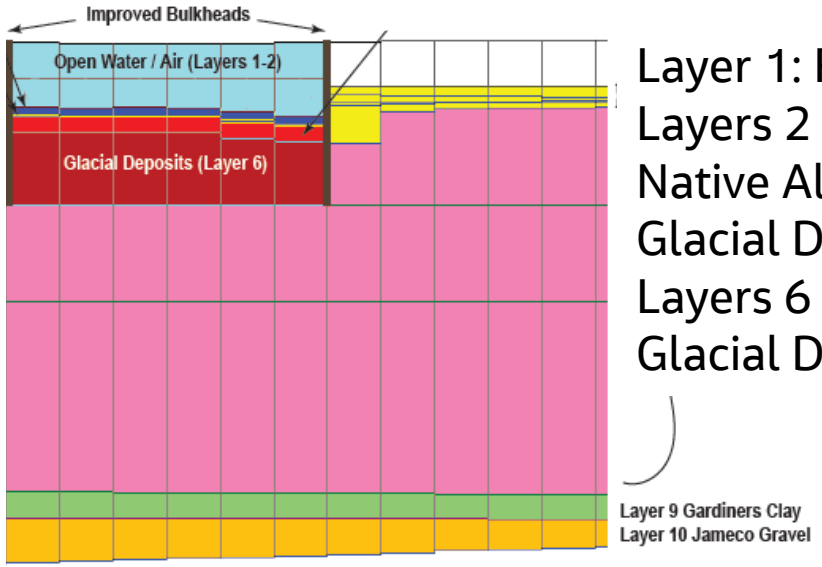
Steady-state capture zones – Model layer 6



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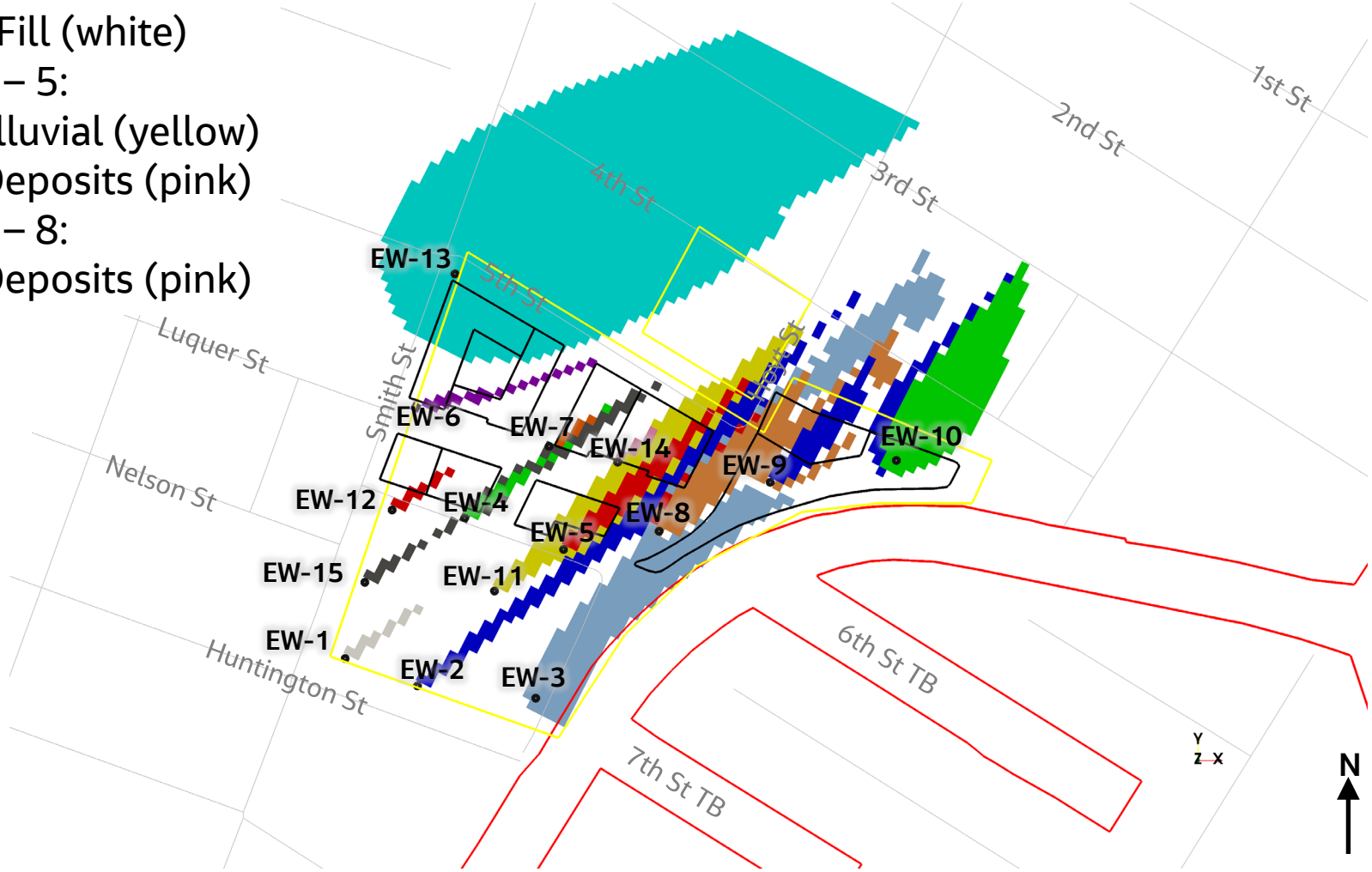

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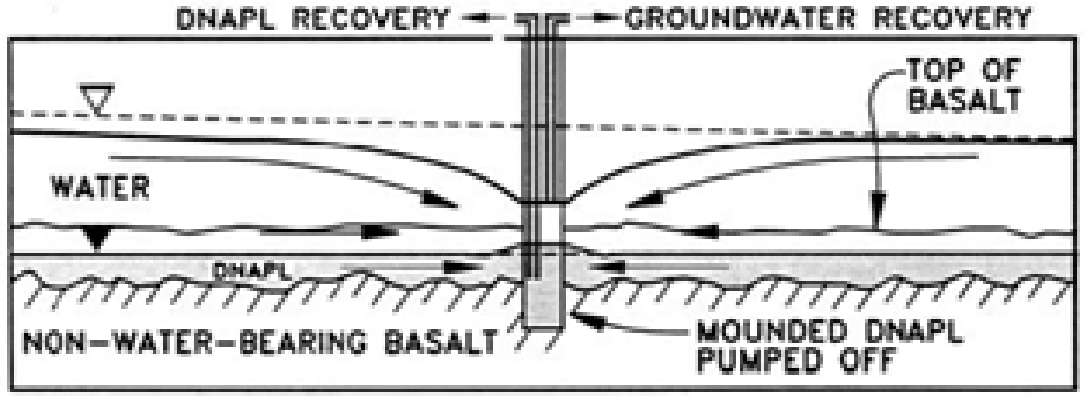
NAPL recovery considerations

How might operation of extraction wells in the Citizens parcel affect NAPL migration?

What approach could be used to eliminate or minimize sources near groundwater pumping well locations?

GW extraction could potentially increase DNAPL recovery

- GW extraction enhances DNAPL recovery
- GW depression induces upconing of DNAPL into the extraction well



Mobile NAPL Recovery: Conceptual, Field, and Mathematical Considerations

by Tom Sale[a] and David Applegate[b]

1997. Ground Water, 35(3), pp. 418-427.

Abstract

Recovery of mobile Nonaqueous Phase Liquids (NAPLs), referred to as "oil recovery," is one of the most common remedial technologies currently being implemented at sites where NAPLs have been released. The rationale for oil recovery typically includes resource recovery, mitigation of further NAPL migration, and compliance with regulatory mandates for source reduction. Efficient oil recovery can be achieved by optimizing conditions within the oil flow path. This concept is referred to as flow path management. Building on this concept, a waterflood oil recovery technique utilizing dual recovery and parallel delivery drainlines has been developed for recovery of creosote-based wood-treating oil, a Dense Nonaqueous Phase Liquid (DNAPL). Full-scale application of this technique at a contaminated site has yielded 1.5 million gallons of DNAPL. Furthermore, an operational endpoint of 95 percent recovery of the mobile oil is being achieved. Building on the concept of flow path management and the observed performance of the waterflood oil recovery system, a first-order analytical solution for DNAPL flow to a drainline has been derived and validated using field data. This solution leads to a set of useful design equations and further insight into the factors that control oil recovery.

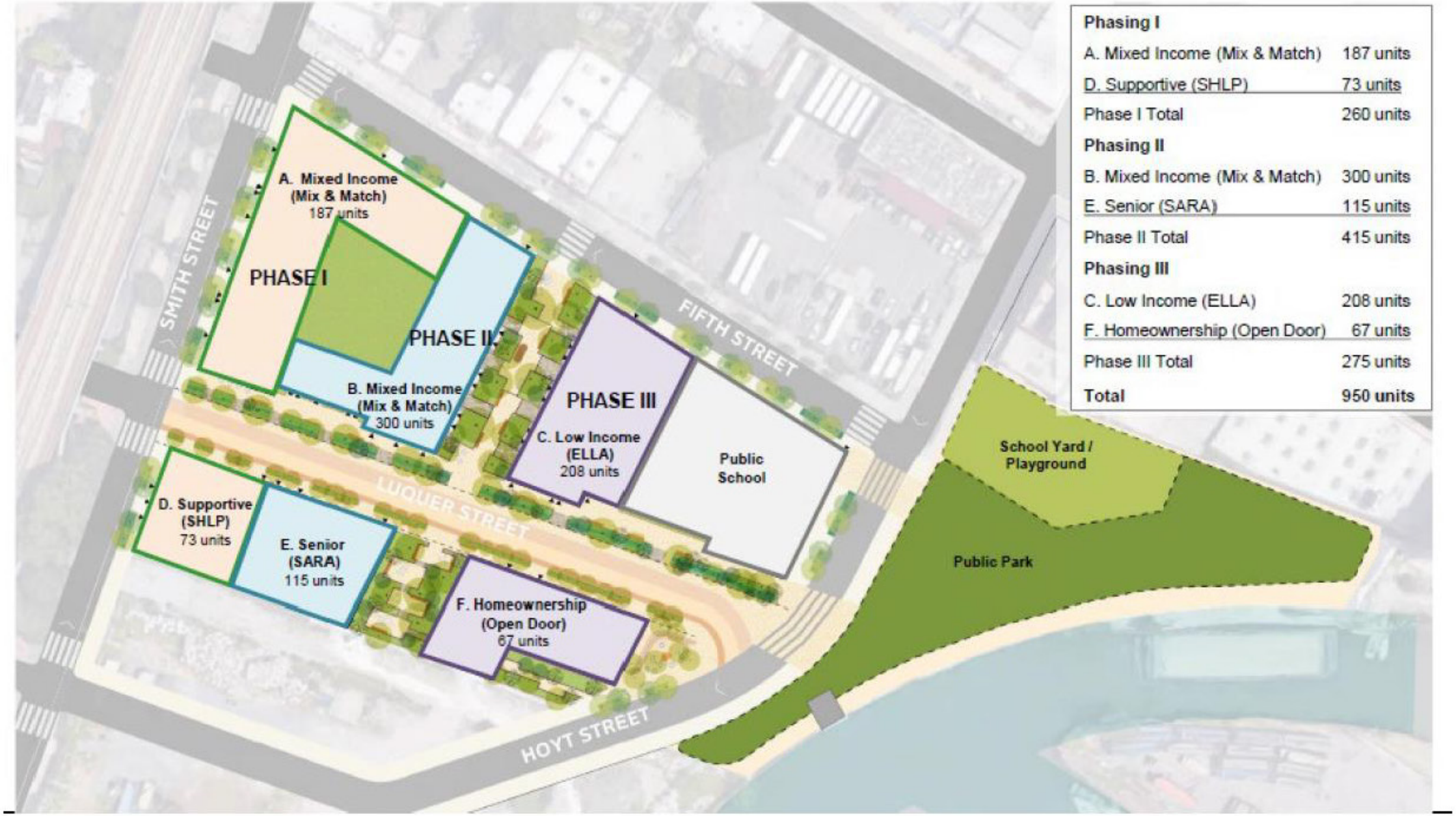
Mounding considerations

Following the in-canal remediation in RTA2, in conjunction with the new bulkheads that the remediation requires, will groundwater mounding occur at the Citizens site under steady state conditions?

How might operation of hydraulic-capture extraction wells in the Citizens parcel reduce mounding effects caused by implementation of the Canal remedy?

What volumetric capacity/flowrate may be anticipated for possible treatment and discharge based on assumed number of wells?

PROPOSED AFFORDABLE HOUSING PHASING PLAN



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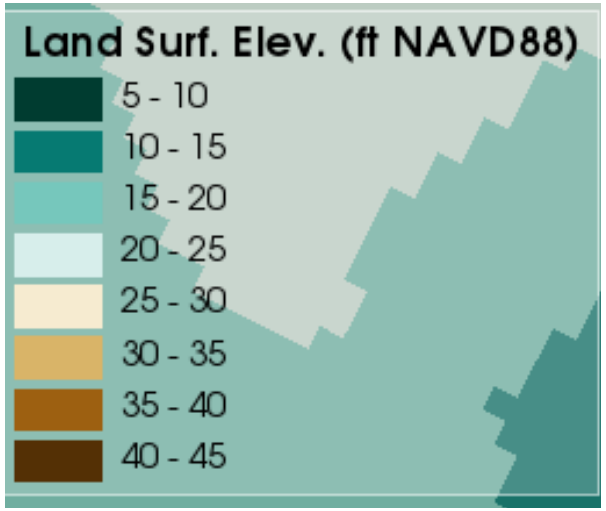
Total	**950 units**

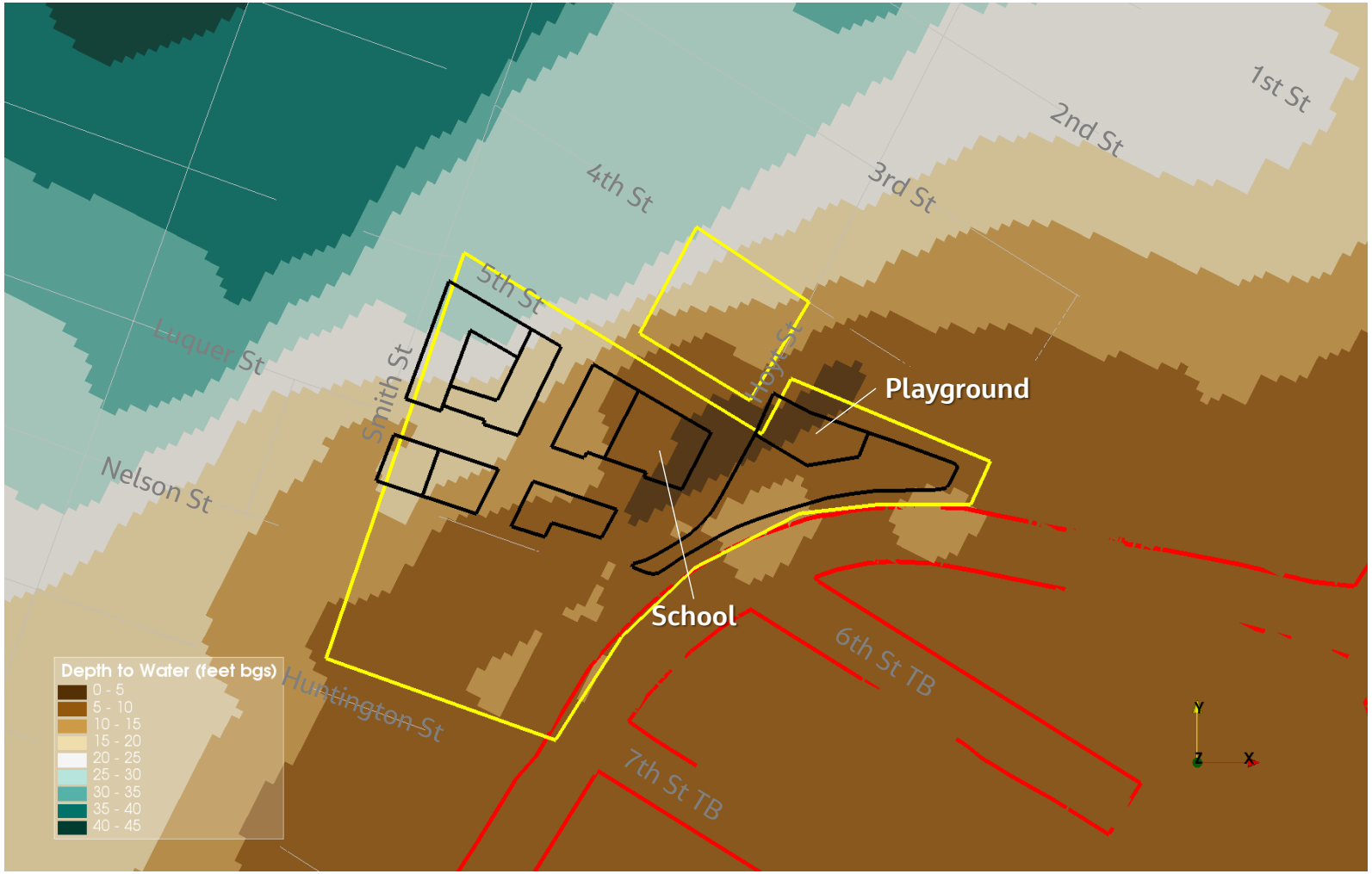
Modeled land surface elevation

- Modeled land surface elevations indicate ~20’ of relief across the site
- Is this consistent with the redevelopment grade?



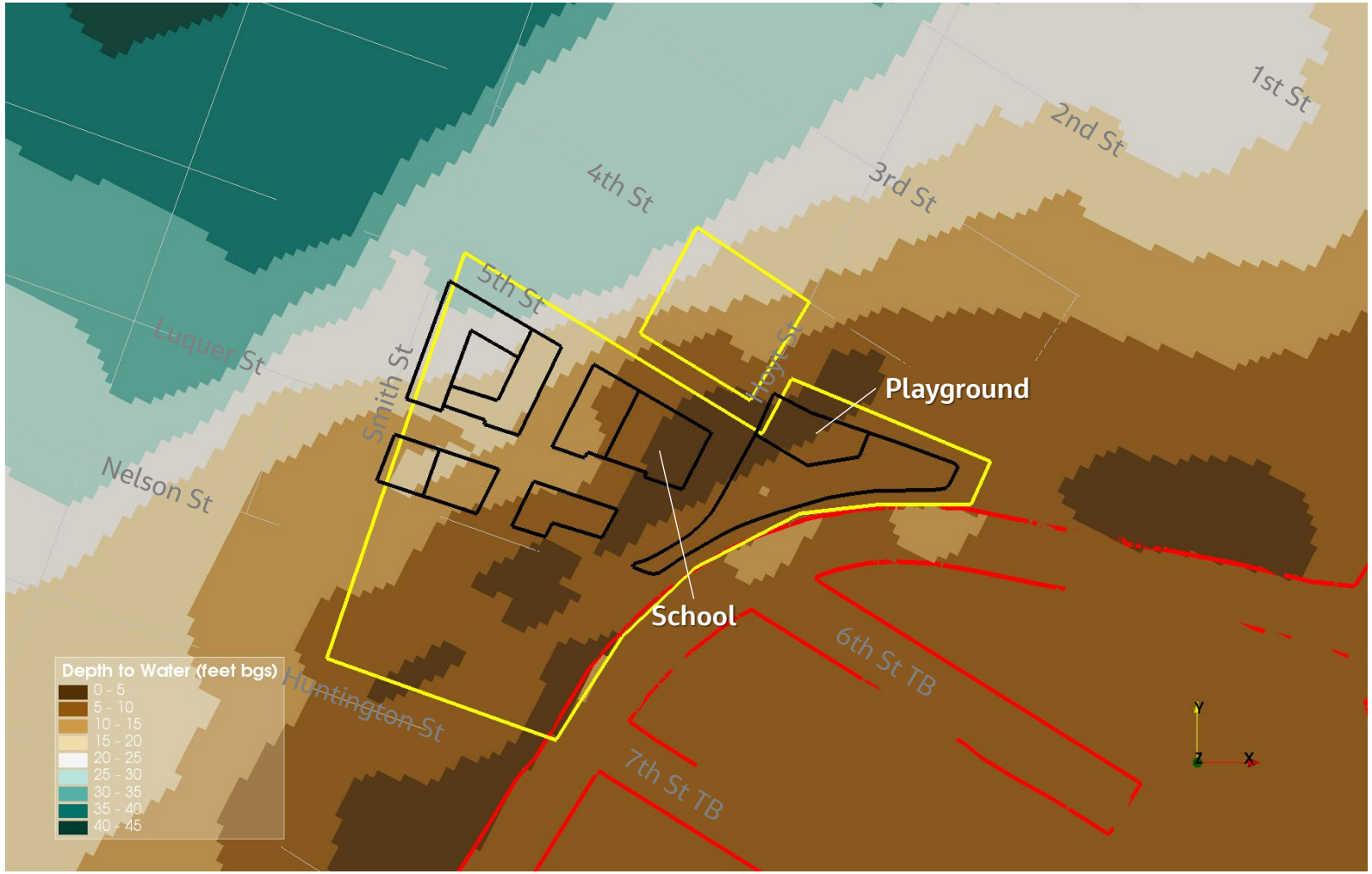
N

Depth to water – Baseline



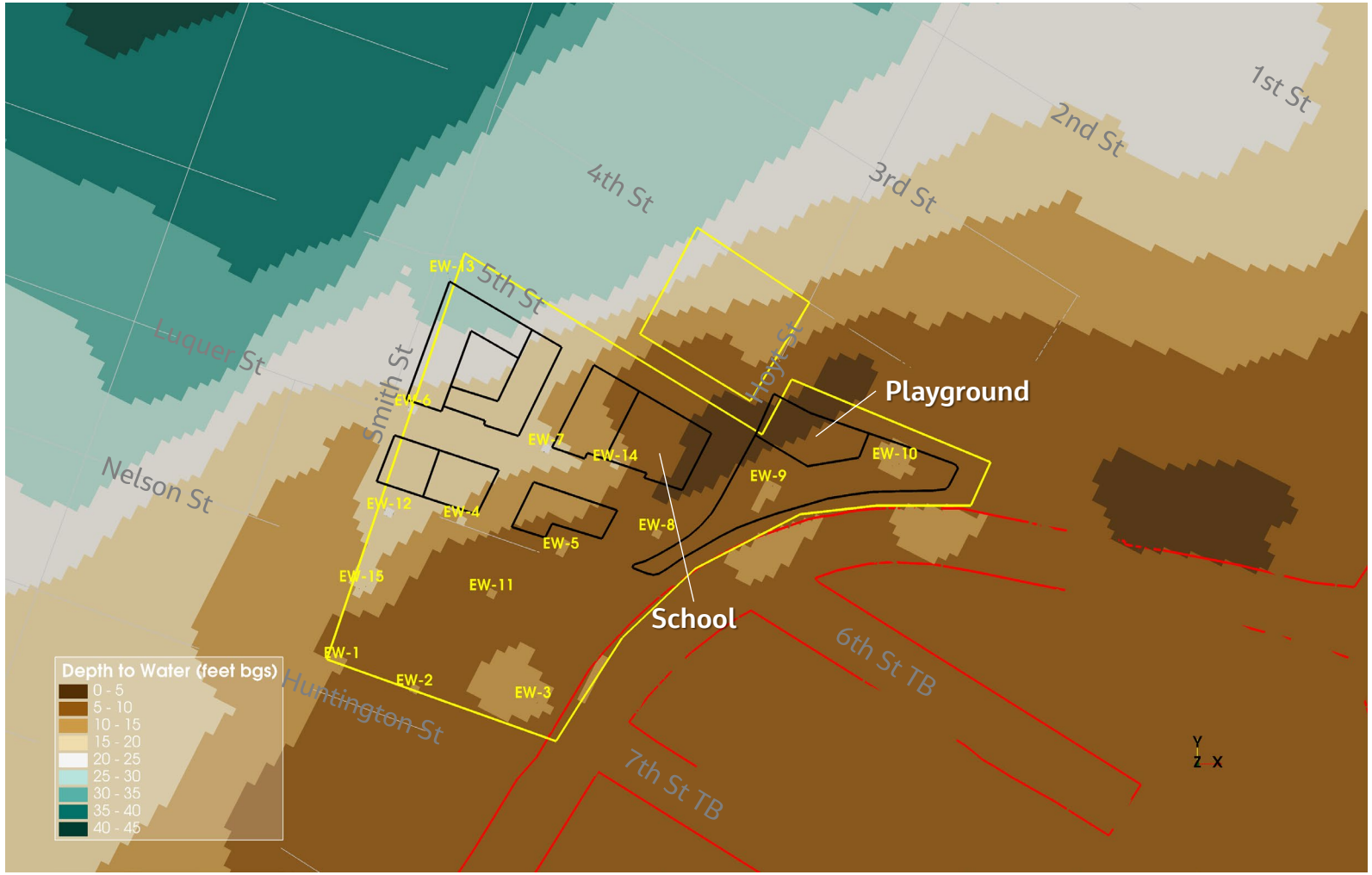
N

Depth to water – Post-remedy without GW extraction in upland



N

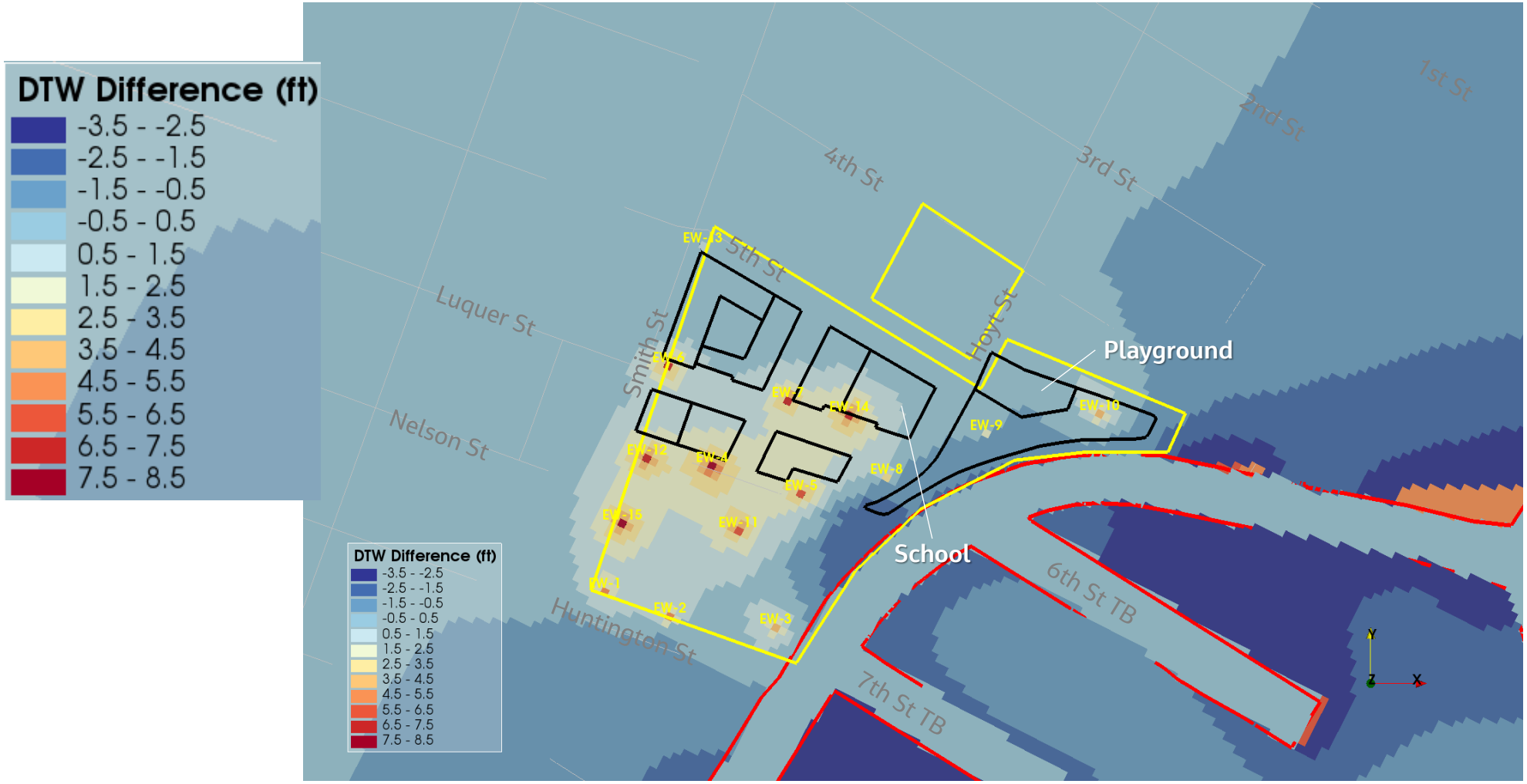
Depth to water – Post-remedy <u>with</u> GW extraction in upland



N

This is not an extraction well-field design. A proper capture zone analysis would need to be done for the design.

Pumping depth to water under Post-remedy conditions <u>with</u> GW extraction in upland minus Baseline depth to water



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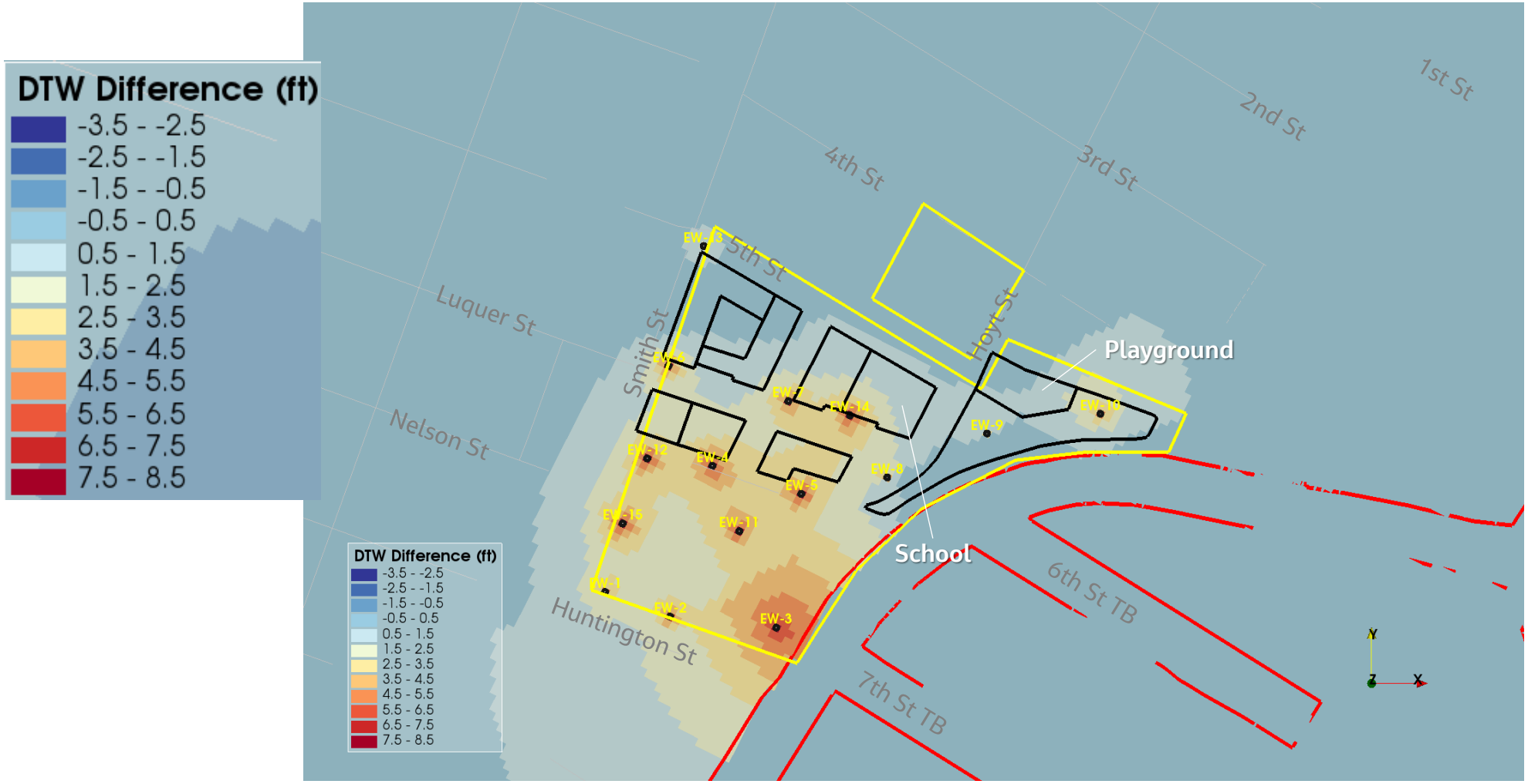
Pumping depth to water under Post-remedy conditions <u>with</u> GW extraction in upland minus Post-remedy conditions <u>without</u> GW pumping



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Preliminary findings

- The following could facilitate achieving RAOs:
  - Extraction wells could mitigate contaminant migration into the Canal
  - DNAPL recovery with GW extraction could be used to control the primary source areas
- Mounding from implementing the Canal remedy could also be mitigated from incorporating hydraulic-capture extraction wells